Title	Conformational Hysteresis on A Giant DNA Molecule
Author(s)	Higuchi, Yuji; Shew, Chwen-Yang
Citation	物性研究 (2006), 87(1): 127-128
Issue Date	2006-10-20
URL	http://hdl.handle.net/2433/110615
Right	
Type	Departmental Bulletin Paper
Textversion	publisher

Conformational Hysteresis on A Giant DNA Molecule

Dept. of Physics, Kyoto Univ. Yuji Higuchi [1]
Dept. of Chemistry, City Univ. of New York Chwen-Yang Shew [2]

中性高分子、高価カチオン、陽イオン性界面活性剤などの凝縮剤の添加によりDNA高分子鎖は凝縮転移を引き起こす。近年、蛍光顕微鏡を用いた単分子観測によりcoilから凝縮状態への不連続な転移（一次相転移）であることが明らかになった。本研究では中性で水溶性の高分子である、PEG濃度を変化させることで、凝縮、脱凝縮過程を観測した。その結果、凝縮・脱凝縮過程ではPEGの転移点濃度に明瞭な差が生じ、数時間以上の時間経過でみると履歴の幅はほぼ一定値を示すことがわかった。。凝縮過程と脱凝縮過程の差異は、転移の道筋が異なるためである。

1 Introduction

A single molecular fluorescence image experiment has been conducted to elucidate the conformational behavior of a giant DNA molecule in aqueous solution. By adding condensing agents, such as PEG (Poly Ethylene Glycol), a random coiled giant DNA molecule undergoes folding to form compact structure. [1, 2] Such a transition exhibits the features of the first-order phase transition, with two coexistent elongated and compact conformations. [1, 2] In this work, we carry out the titration and back-titration with an increase and a decrease of PEG concentration, respectively, to investigate the DNA conformation mediated by condensing agents.

2 Experiment

A giant T4 DNA (165.5 kbp) molecule in PEG solution shows two distinct conformational states, elongated and compact, which can be characterized through their large density difference (above 10^4 times). Here, two sets of experiment are carried out, including titration and back-titration. In titration, the PEG concentration is increased by keeping the T4 DNA concentration fixed, whereas in back-tiration, the PEG concentration is diluted. After mixing PEG with T4 DNA, the solution stands for 1 hour or 2 hours before the ratio of the compact state is measured.

3 Results and Discussion

Figure 1 displays the ratio of the compact state of a giant T4 DNA with PEG concentration obtained from titration and from back-titration. A pronounced conformational hysteresis is

[1]E-mail:higuchi@chem.scphys.kyoto-u.ac.jp
[2]E-mail:shew@mail.csi.cuny.edu

observed. In the titration experiment, more T4 DNA molecules fold as the PEG concentration is increased and/or after the solution stands for two hours. In back-titration, the T4 DNA molecule tends to unfold, but the ratio of compact conformation becomes independent of time. These results suggest different pathways between the forward and backward titrations.

4 Conclusions

The forward and backward titrations with PEG are conducted to investigate the conformational behavior of a giant T4 DNA molecule. Our findings show a pronounced conformational hysteresis for folding and unfolding processes, indicating different pathways for these processes.

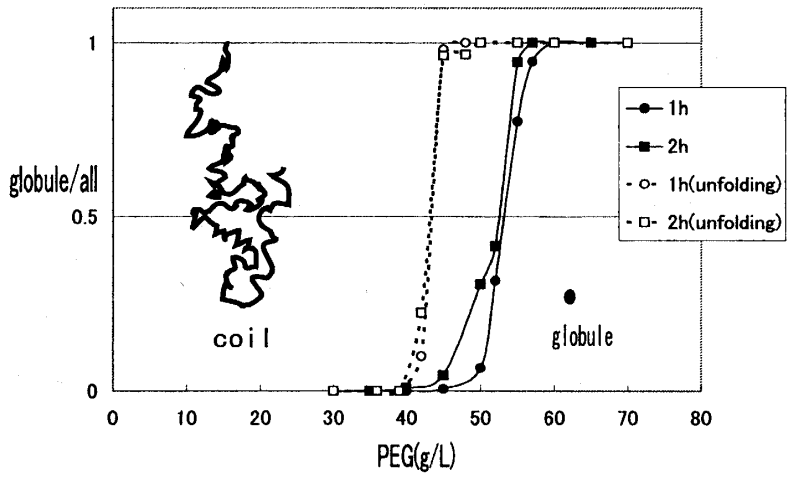

Figure 1: Plot of the ratio of the compact state of a giant T4 DNA with PEG concentration obtained from forward titration, solid symbols, and from back-titration, open symbols after the mixture stands for one hour, circles, and for two hours, squares. The conformations of the two different states are shown: coiled DNA on left and globule DNA (condensed) on right.

Acknowledgment

We thank Prof. Yoshikawa (Kyoto Univ.) for his stimulating comments and suggestions. CYS thanks for the partial support from PSC-CUNY award, and CePM and MMA at CSI/CUNY.

References

[1] K. Yoshikawa and Y. Matsuzawa, "Nucleation and growth in Single DNA Molecules", *J. Am. Chem. Soc.* **118**, 929-930 (1996).

[2] K. Yoshikawa, *Adv. Drug Delivery Rev.* **52** (2001) 235.